Corrosion inhibitors for Oilfield applications
Unleash the full potential of your corrosion inhibitor formulations

We have a long history of supplying the Oil- and Gas Industry with efficient and reliable corrosion inhibitor bases for multiple uses. With our wide portfolio of surfactants and polymers, deep organic and surface chemistry knowledge, sustainability focus, regulatory expertise and global footprint, we can help you all the way from the design of your formulation to the final use of your product.

Our offering includes a range of base inhibitors (Armohib CI series), the heart of the formulation, as well as a number of versatile co-inhibitors and/or co-surfactants. Most of these are based on amine chemistry, but also e.g. phosphate ester based enhancers are available. Some of the co-inhibitors may also be used as primary inhibitors for special cases outside the upstream oilfield area, like in high-temperature environments such as refineries or boilers/condensers in Water Treatment systems. In addition, we provide formulation aids and wetting agents, ideal to resolve compatibility challenges or top-up the integrity or performance of your formulations. More over, we supply highly efficient proprietary blends for HCl- or organic acid inhibition.

This brochure features a deep-dive into some of our Armohib CI products as well as an overview table showing our offering in the area.

A selection guide is provided below, as well as some formulation examples and selected performance data.

Want to know more? Ask us!

Armohib® CI-219

highest standard imidazoline corrosion inhibitor

High imidazoline content, can be formulated to meet various harsh corrosion challenges

Imidazoline chemistry is the basis for one of the dominating types of film-forming organic corrosion inhibitors for oil- and gas installations globally. With Armohib CI-219, we offer a superior quality Tall Oil Fatty Acid (TOFA) imidazoline.

Features
- High imidazoline contents, >70%
- Flexible solubility profile for different purposes by organic acid addition
- Easy to handle, clear liquid at room temperature, and with a pour point well below -15°C
- High film persistence independently proven by AFM measurements
- Laboratory validated excellent sour corrosion inhibition performance for low salinity brines and moderate temperatures

Recommended uses
- For low- and middle range temperature oil-and gas recovery, treatment or transport scenarios
- Formulated as oil soluble, oil soluble-water dispersible or water soluble-oil dispersible depending on requirement of the specific application
- Formulation with enhancers such as Na-thiosulfate is possible and will boost performance versus sweet corrosion further

Armohib CI-209

Armohib CI-209 is a variant of CI-219 based on regionally sourced raw materials, can be applied the same way.

Formulation and performance examples

**Water based, high Fp, high neutralization**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Concentration, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armohib CI-219</td>
<td>24</td>
</tr>
<tr>
<td>GAA</td>
<td>10</td>
</tr>
<tr>
<td>BDG</td>
<td>13</td>
</tr>
<tr>
<td>Water</td>
<td>up to 100</td>
</tr>
</tbody>
</table>

The pH 2% in water of this water soluble/oil dispersible formulation will be around 5.0.

**Solvent based, for gas pipelines, etc**

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Concentration, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Armohib CI-209</td>
<td>15</td>
</tr>
<tr>
<td>Diethanol amine</td>
<td>15</td>
</tr>
<tr>
<td>GAA</td>
<td>10</td>
</tr>
<tr>
<td>Mutual solvent</td>
<td>35</td>
</tr>
<tr>
<td>Aromatic solvent</td>
<td>up to 100</td>
</tr>
</tbody>
</table>

For these types of systems, the film forming amine should ideally be mixed with a volatile amine.

**Sweet corrosion inhibition performance with Armohib CI-219 as single inhibitor in a two-phase system, no enhancer added**

<table>
<thead>
<tr>
<th>Corrosion rate (mm/yr)</th>
<th>Time (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>10 ppm added</td>
</tr>
<tr>
<td>0.1</td>
<td>10 ppm added</td>
</tr>
<tr>
<td>0.07</td>
<td>15 ppm added</td>
</tr>
<tr>
<td>0.04</td>
<td>20 ppm added</td>
</tr>
<tr>
<td>0.01</td>
<td>25 ppm added</td>
</tr>
</tbody>
</table>

Armohib CI-300

Armohib CI-209

Armohib CI-219

Ethoquad O/22 PG

Ethoquad C/25

Ethoduoomeen T/22

Ethoduoomeen T/25

Duomeen O

Duromoomeen T/15

Ethomoomeen T/15

Armeen C

Armeen O

Secondary inhibitors / Formulations aids

Duomoomeen T/22

Ethomoomeen T/22

Armohib CI-31

HCl- or organic acid inhibition.

Recommended uses
- Formulation with an oil soluble, oil soluble-water dispersible or water soluble-oil dispersible depending on requirement of the specific application
- Formulation with enhancers such as Na-thiosulfate is possible and will boost performance versus sweet corrosion further

Selection guide
Armohib® CI-5150
for exemplary corrosion control

With unique chemistry, Armohib CI-5150 meets the strictest environmental requirements and is extremely easy to use.

Technology
This novel inhibitor technology has been developed specifically for use in the oilfield. It is designed to maintain exemplary corrosion control compared with industry standards, whilst having clearly improved ecotoxicity characteristics. This allows the material to be used in environmentally sensitive marine locations.

The unique, patented film-forming alkyloquaternary amine-based chemistry displays multiple positive-charge functionality along the oligomer chain providing several points of adhesion to the metal surface, giving great film integrity under various conditions. In addition, this chemistry results in first class brine compatibility. Armohib CI-5150 demonstrates excellent oil to brine partitioning in discrete phase laboratory tests, currently involving data up to +80°C and above.

Recommended uses
- Sweet corrosion / pipeline applications
- Severe brine environments
- Corrosion control in environmentally sensitive oilfield production applications
- Topside or umbilical-fed production systems that require film-forming corrosion control
- Formulated in various organic or aqueous systems for ease of use and/or minimized cost/performance profile
- High flashpoint blends as well as methanol-based formulations for extremely cold conditions can be recommended
- Use in alkaline water-based formulations is not recommended

Regulatory information
Armohib CI-5150 is REACH and TSCA compliant. In addition, it is approved for all parts of the North Sea as well as any other region applying OSPAR regulations. It is classified WGR in Germany (water hazard class).

Features
- Excellent sweet corrosion inhibiting properties when tested under standard conditions and against benchmark chemistries, 99.8% protection at 10 ppm dosage in a non-optimized formulation demonstrated
- Corrosion reduction of >99% at 10 ppm dosage demonstrated in RCE (30 Pa wall shear stress) tests, indicating stable performance also under high flow conditions (data obtained in 3% NaCl brine at +60°C)
- Compatible with heavy brines as e.g. 26% NaCl, 20% NaCl at +70°C, >30% CaCl₂ and 50 000 ppm CaCl₂ 0.00 ppm Na brine at +80°C
- Promising performance also for organic acid inhibition at elevated temperature, e.g. >95% protection of carbon steel in 10% citric acid after 24h at +95°C
- Low order of ecotoxicity, making the product suitable for use in the most stringent regulatory environments
- Aquatoxicity 10-100 times lower than for common oilfield CI bases such as benzalkonium chlorides and imidazolines, no dangerous to the environment label
- Testing has shown CI-5150 is not skin irritating, sensitizing or mutagenic
- Easy to handle, being a clear liquid at room temperature
- In-house formulation studies have shown the active material to be extremely flexible when formulated, allowing the chemist to develop both aqueous and solvent based corrosion inhibitor solutions, including with environmentally acceptable solvents

Armohib® CI-5174
a versatile corrosion inhibitor

Proven to reduce total inhibitor dosage

Armohib CI-5174 is an innovative, oligomeric amine for cutting edge formulations.

Technology
This novel corrosion inhibitor technology, developed specifically for use in the oilfield, has been designed to maintain exemplary corrosion control while offering versatile functionality and highest ease of handling, allowing the material to be used in a variety of formulation alternatives.

The film-forming alkylo polyamine-based chemistry results in multiple heteroatom functionality along the polymer chain, which is believed to enable several points of adhesion to the metal surface giving greater film integrity under various conditions. Feedback from the field indicates a maintained level of corrosion protection in spite of lower dosage levels and longer intervals between dosage compared to previously used chemistry.

Armohib CI-5174 demonstrates excellent oil to brine partitioning in discrete phase laboratory tests and distribution properties can easily be tuned by modifying the solubility profile, for example by adding acetic acid.

Recommended uses
- Sweet and sour corrosion / pipeline applications
- Topside or umbilical-fed production systems that require film-forming corrosion control
- Corrosion applications where turbulent fluid flow compromise film integrity leading to excess corrosion rates or and/or high dosage of standard active inhibitor
- Formulated in various organic solvents or in aqueous solutions for ease of use and optimized cost/performance profile
- High flashpoint blends as well as methanol-based formulations for extremely cold conditions and/or umbilical application can be recommended
- Replacement for imidazolines when not suitable due to e.g. local regulations or difficult brine conditions

Features
- Excellent sweet corrosion inhibiting properties when tested under standard conditions and against benchmark chemistries, 99.8% protection at 10 ppm dosage in a non-optimized formulation demonstrated
- Compatible with base inhibitor synergists such as Na-thiosulfate
- Combined H₂S- and CO₂-corrosion inhibitor
- Protective film integrity also under high flow conditions demonstrated by RCE testing, where a 10 ppm active inhibitor dosage yielded 99% protection at 30 Pa wall shear stress (data obtained in 3% NaCl brine at +60°C)
- Easy to handle, being a clear liquid at room temperature and having a pour-point of ~12°C
- A significantly lower foam profile than e.g. alkyl benzalkonium chlorides and fatty acid imidazoline acetates
- Improved brine tolerance compared to standard imidazolines
### Corrosion inhibitors overview

<table>
<thead>
<tr>
<th>Physical form</th>
<th>Chemistry</th>
<th>Active content</th>
<th>Pour point °C</th>
<th>Viscosity mPa.s (20°C)</th>
<th>Flash point °C</th>
<th>pH</th>
<th>Foam mm³/5 min</th>
<th>Surface tension mN/m</th>
<th>Solubility</th>
<th>Functionality and use</th>
<th>Regulatory data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid</td>
<td>Proprietary surfactant blend</td>
<td>-</td>
<td>0</td>
<td>&gt;150</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Organic acids inhibitor</td>
<td>Add to acid solution</td>
<td>Yes</td>
</tr>
<tr>
<td>Liquid</td>
<td>Polyamine + TOFA imidazole</td>
<td>100%</td>
<td>0</td>
<td>800</td>
<td>&gt;228</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>DETA + TOFA imidazole</td>
<td>100%</td>
<td>-15</td>
<td>210</td>
<td>&gt;125</td>
<td>10.5-12.5</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>TEPA + TOFA imidazole</td>
<td>100%</td>
<td>7</td>
<td>430</td>
<td>&gt;100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
<td>Oligomeric Ester Amine</td>
<td>100%</td>
<td>-18</td>
<td>525</td>
<td>&gt;100</td>
<td>7</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
<td>Oligomeric Ester Quat</td>
<td>55% (in BDG)</td>
<td>-5</td>
<td>3500</td>
<td>90-94</td>
<td>3.3-4.1</td>
<td>115/102</td>
<td>31</td>
<td>S</td>
<td>S</td>
<td>D</td>
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<tr>
<td>Liquid</td>
<td>Oligomeric Ester Amine</td>
<td>100%</td>
<td>-12</td>
<td>1185</td>
<td>&gt;200</td>
<td>7-8</td>
<td>250</td>
<td>-</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
<td>Ethoquad C/12</td>
<td>100%</td>
<td>8</td>
<td>nd</td>
<td>193</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>nd</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethoquad C/15</td>
<td>100%</td>
<td>15</td>
<td>150</td>
<td>&gt;100</td>
<td>9-11</td>
<td>101/70</td>
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<td>S</td>
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<td>S</td>
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<td>Liquid</td>
<td>Ethoquad C/25</td>
<td>100%</td>
<td>-10</td>
<td>210</td>
<td>&gt;100</td>
<td>9-11</td>
<td>161/35</td>
<td>38</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
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<td>100%</td>
<td>1</td>
<td>150</td>
<td>&gt;100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
<td>Ethomeen T/12</td>
<td>100%</td>
<td>12</td>
<td>34</td>
<td>160</td>
<td>&gt;100</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>nd</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethomeen T/30</td>
<td>100%</td>
<td>8</td>
<td>160</td>
<td>&gt;100</td>
<td>10</td>
<td>35/35</td>
<td>31</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
<td>Ethomeen T/25</td>
<td>100%</td>
<td>5</td>
<td>310</td>
<td>&gt;100</td>
<td>10</td>
<td>55/35</td>
<td>39</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethomeen T/13</td>
<td>100%</td>
<td>20</td>
<td>950</td>
<td>&gt;100</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethomeen T/22</td>
<td>100%</td>
<td>8</td>
<td>360</td>
<td>&gt;100</td>
<td>-</td>
<td>101/35</td>
<td>38</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethomeen T/22</td>
<td>100%</td>
<td>8</td>
<td>360</td>
<td>&gt;100</td>
<td>-</td>
<td>101/35</td>
<td>38</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethoxylated Amino Diamines</td>
<td>100%</td>
<td>8</td>
<td>nd</td>
<td>193</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>D</td>
<td>nd</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Ethoxyalcohol C/15</td>
<td>100%</td>
<td>15</td>
<td>1150</td>
<td>127</td>
<td>6-8</td>
<td>nd</td>
<td>43</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<tr>
<td>Liquid</td>
<td>Ethoxyalcohol C/15</td>
<td>100%</td>
<td>15</td>
<td>1150</td>
<td>127</td>
<td>6-8</td>
<td>nd</td>
<td>43</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Cocobenzyl dimethyl ammonium chloride</td>
<td>50% (in water)</td>
<td>nd</td>
<td>130</td>
<td>&gt;100</td>
<td>6-9 (10%)</td>
<td>89/18</td>
<td>-</td>
<td>S</td>
<td>nd</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Cocobenzyl dimethyl ammonium chloride</td>
<td>50% (in water)</td>
<td>nd</td>
<td>130</td>
<td>&gt;100</td>
<td>6-9 (10%)</td>
<td>89/18</td>
<td>-</td>
<td>S</td>
<td>nd</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Aqualon PE169</td>
<td>100%</td>
<td>10</td>
<td>900</td>
<td>&gt;150</td>
<td>2-3</td>
<td>108/78</td>
<td>28</td>
<td>D</td>
<td>S</td>
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<td>Liquid</td>
<td>Aqualon PE65</td>
<td>100%</td>
<td>12</td>
<td>198</td>
<td>&gt;150</td>
<td>2-3</td>
<td>108</td>
<td>-</td>
<td>D</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Formulation aids and Wetting agent</td>
<td>100%</td>
<td>9</td>
<td>30</td>
<td>&gt;100</td>
<td>7-9.5</td>
<td>5/8</td>
<td>27</td>
<td>D</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Liquid</td>
<td>Armoclean 6300</td>
<td>65% (in water)</td>
<td>nd</td>
<td>160 (4.33)</td>
<td>&gt;100</td>
<td>6-8</td>
<td>8/0</td>
<td>33</td>
<td>S</td>
<td>nd</td>
<td>i</td>
</tr>
<tr>
<td>Liquid</td>
<td>Armoclean 6400</td>
<td>75% (in water)</td>
<td>-9</td>
<td>775</td>
<td>&gt;100</td>
<td>6-8</td>
<td>0/0</td>
<td>34</td>
<td>D</td>
<td>nd</td>
<td>i</td>
</tr>
</tbody>
</table>

* regional Americas variant of CI-219

溶疲性

### Functionality and use

<table>
<thead>
<tr>
<th>Water</th>
<th>Methanol</th>
<th>IPA</th>
<th>BDG</th>
<th>Organic solvent</th>
<th>Aromatic solvent</th>
<th>Diesel</th>
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</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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### Regulatory data

<table>
<thead>
<tr>
<th>TSCA</th>
<th>REACH</th>
<th>approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: **NI** = no data

**Solubility**

- **3% in 80/20 water/IPA**
- **+ g at 40°C**
- **+ g at pH 6**

**Formulation aids and Wetting agent**

- **Biocide for fracking (US)**
- **Oxygen corrosion inhibition**
- **Oil soluble, liquid**

**Cleaning**

- **Add intensifier**
- **High temp / High brine**
- **High temp / High brine**

**General characteristics**

- **Physical form**
- **Chemistry**
- **Active content**
- **Pour point °C**
- **Viscosity mPa.s (20°C)**
- **Flash point °C**
- **pH**
- **Foam mm³/5 min**
- **Surface tension mN/m**

**Solubility**

- **Water**
- **Methanol**
- **IPA**
- **BDG**
- **Organic solvent**
- **Aromatic solvent**
- **Diesel**

**Main uses**

- **Formulability**
- **Special properties**

*IPA = Isopropyl alcohol

*PG = Propylene glycol

*BDG = Butyl diglycol

*REACH = Regulation (EC) No 1907/2006

*TSCA = Toxic Substances Control Act

*Sec = Secondary

*HT = High temp (>120°C)
Nouryon is a global, specialty chemicals leader. Markets and consumers worldwide rely on our essential solutions to manufacture everyday products, such as personal care, cleaning goods, paints and coatings, agriculture and food, pharmaceuticals, and building products. Furthermore, the dedication of more than 7,900 employees with a shared commitment to our customers, business growth, safety, sustainability and innovation has resulted in a consistently strong financial performance. We operate in over 80 countries around the world with a portfolio of industry-leading brands. Visit our website and follow us @Nouryon and on LinkedIn.